

Serial No. 10/032,478

Attorney Docket No. 259/010 CIP

**REMARKS****I. Introduction**

All pending claims 1-18 were finally rejected. In the instant Amendment, claims 1-7, 10-12 and 16-18 have been amended, and new claims 19-36 have been entered. No new matter has been introduced into the claims by way of these amendments. Applicants respectfully submit, that in view of the above amendments to the claims and the following remarks, all pending claims 1-36 are in condition for allowance.

**II. Final Office Action of January 3, 2003**

In the Final Office Action mailed January 3, 2003:

1. The drawings were objected to under 37 C.F.R. §1.83(a) on the basis that the limitations that the solder ball completely enclose a first volume and a completely enclosed interior cavity are not shown in the drawings.

2. Claims 1-18 were rejected under 35 U.S.C. § 112, first paragraph, on the basis that while all of the claims contain a limitation requiring the solder ball to completely enclose a first volume and a completely enclosed interior cavity, the disclosure of the instant application only describes partially enclosed first volumes and interior cavities. Accordingly, the disclosure was deemed as non-enabling for this limitation.

3. Claims 1-3 were rejected under 35 U.S.C. § 102(e) as being anticipated by United States Patent No. 6,303,408 to Smith ("Smith"), on the basis that Smith discloses, referring to Fig. 1, an array of solder bonding structures (22) having a continuous curved exterior (42) completely enclosing a first volume and interior cavity (4), the ball

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connecting two metal contacts (26, 32) [claim 1], wherein the second volume is greater than 1% of the first volume [claim 2] yet smaller than 90% of the first volume [claim 3].

4. Claims 4-18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith in view of Applicants' Admitted Prior Art ("AAPA") described with reference to figures 1 and 2. Regarding claims 4-7, 10-12, 16 and 17, the rejection asserts that although Smith does not specifically state that the invention is a BGA, it would have been obvious, to one having ordinary skill in the art, at the time of invention, to use a BGA as it is well known in the art to package chips in BGAs as evidenced by AAPA. The rejection points out further that the AAPA teaches that the substrates may be either organic or inorganic, including ceramic and glass-epoxy, as both are well known in the art [claims 8, 9, 13-15, and 18].

### **III. Discussion**

#### 1. Objection to the Drawings.

In view of the amendments to the claims, applicants respectfully submits that the objection to the drawings has been rendered moot. As amended, the claims are directed to solder bonding or ball structures having a continuous curved exterior surface which, together with a first surface and a second surface and their respective contact pads, define a total volume of each solder bonding or ball structure and completely encloses an interior cavity defined by an interior surface of the solder bonding or ball structure, the interior cavity having a displacement constituting a second volume, wherein the interior cavity is in direct contact with the interior surface of the solder bonding or ball structure and the second volume is not less than about 1% and not more than about 90% of the

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total volume of the solder bonding structure. These limitations are shown in the drawings. Accordingly, applicants respectfully request that the objection to the drawings be favorably reconsidered and withdrawn.

2. Rejection of Claims 1-18 under 35 U.S.C. § 112, first paragraph.

In view of the amendments to the claims, applicants respectfully submits that the rejection of claims 1-18 under 35 U.S.C. § 112, first paragraph, is hereby traversed. As amended, the claims are directed to solder bonding or ball structures having a continuous curved exterior surface which, together with a first surface and a second surface and their respective contact pads, define a total volume of each solder bonding or ball structure and completely encloses an interior cavity defined by an interior surface of the solder bonding or ball structure, the interior cavity having a displacement constituting a second volume, wherein the interior cavity is in direct contact with the interior surface of the solder bonding or ball structure and the second volume is not less than about 1% and not more than about 90% of the total volume of the solder bonding structure. Accordingly, applicants respectfully submit that the claims no longer require the solder bonding or ball structure alone to completely enclose a total or "first" volume and interior cavity, since it is in conjunction with a first surface and a second surface and their respective contact pads that a total or "first" volume of each solder bonding or ball structure is defined and an interior cavity completely enclosed therein. The disclosure is completely enabling of the claims as now presented. Accordingly, applicants respectfully request that the rejection of claims 1-18 under 35 U.S.C. § 112, first paragraph, be favorably reconsidered and withdrawn.

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Claims 1-3 were rejected under 35 U.S.C. § 102(e) as being anticipated by United States Patent No. 6,303,408 to Smith ("Smith"), on the basis that:

Smith discloses, referring to Fig. 1, an array of solder bonding structures (22) having a continuous curved exterior (42) completely enclosing a first volume and interior cavity (40), the ball connecting two metal contacts (26, 32) [claim 1], wherein the second volume is greater than 1% of the first volume [claim 2] yet smaller than 90% of the first volume [claim 3].

(Action, page 3).

Applicants respectfully traverse this rejection on the basis that Smith does not disclose the present invention as claimed. Smith discloses a composite conductive element (22) that includes a thin layer of a conductive material (42) which surrounds a core (40) (col. 5, lines 51-53). The thin layer of conductive material may be solder material (col. 6, lines 38-51). The cores are spherical (col. 3, lines 53-54) and may be entirely solid throughout or may comprise a hollow sphere (col. 5, lines 43-45). As set forth by Smith:

The cores may be relatively simply and inexpensive because there is no need for the core to melt during operation; only the thin outer layer of the composite conductive elements must melt in order to provide adequate electrical and thermal interconnections.

(col. 9, lines 3-7).

The cores desirably have melting temperatures well above the operating temperature range of the microelectronic elements, so that the material constituting the cores remains solid during normal operation.

(col. 3, lines 35-39).

As a result of the core, each composite conductive element can be handled and placed even when the fusible material is

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liquid or molten because surface tension will hold the layer of fusible material around the core. In contrast, when the conductive balls completely comprise [sic] a fusible material, the conductive balls cannot be handled while in a molten or liquid state.

(col. 9, lines 12-18).

The spherical cores facilitate movement of the microelectronic elements relative to one another when the conductive material is in a molten condition. ... it is believed that the spherical cores roll on one or both microelectronic elements, and thus act much like miniature bearing balls.

(col. 3, lines 56-62).

Based upon the above-noted teachings of Smith, in the case there the cores are hollow, the "interior cavity" of Smith is completely defined by the interior surface of the spherical cores. As such, the "interior cavity" is never in direct contact with the fusible conductive material (i.e., solder material) that covers the cores, but instead is in direct contact with the interior surface of the hollow spherical cores. In contrast, the "interior cavity" of the present invention as claimed is defined not by the interior surface of a spherical, hollow core but is instead defined by the interior surface of the solder bonding or ball structure (i.e., the fusible conductive material -- solder material). Smith actually teaches away and discourages from the present invention as claimed. As note above, in comparing the advantages achievable with his spherical core, Smith states that when the conductive balls completely comprise [sic] a fusible material, the conductive balls cannot be handled while in a molten or liquid state.

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On this basis alone, Applicants respectfully submit that the rejection of claims 1-3 under 35 U.S.C. § 102(e) is traversed, and favorable reconsideration and withdrawal of this rejection is respectfully solicited.

4. Rejection of claims 4-18 under 35 U.S.C. § 103(a).

Claims 4-18 were rejected as being unpatentable over Smith in view of Applicants' Admitted Prior Art ("AAPA") described with reference to figures 1 and 2. Regarding claims 4-7, 10-12, 16 and 17, the rejection asserts that although Smith does not specifically state that the invention is a BGA, it would have been obvious, to one having ordinary skill in the art, at the time of invention, to use a BGA as it is well known in the art to package chips in BGAs as evidenced by AAPA. The rejection points out further that the AAPA teaches that the substrates may be either organic or inorganic, including ceramic and glass-epoxy, as both are well known in the art [claims 8, 9, 13-15, and 18].

Applicants respectfully traverse this rejection of claims 4-18 under U.S.C. § 103(a). As stated above in connection with the rejection under 35 U.S.C. § 102(e), Smith does not teach or suggest an "interior cavity" that is in direct contact with the fusible conductive material, i.e., solder material, and actually discourages and teaches away from not using the spherical core (whether solid or hollow).

In regard to AAPA, Figs. 1 and 2 of the present application show conventional BGA structures, wherein small voids that form when the solder material is heated to cause it to melt are shown in exaggerated form to show the presence of such microvoids in the drawings.

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As set forth in the AAPA,

Conventional solder processing typically incorporates a warm-up period to allow time for de-gassing of such solvents, thereby minimizing such voids to yield a recommended finished total gaseous volume of less than 0.1% of the total solder structure volume

(Application, p. 5, paragraph [010].

The present invention as claimed includes an interior cavity that is no less than 1% and no greater than 90% of the total volume of the solder bonding or ball structure, and is distinguished over prior art solder structures that include microvoids that have a cumulative gaseous volume of less than 0.1% of the total solder structure volume.

In combining the teachings of Smith and the AAPA, one of skill in the art would not arrive at the present invention as claimed. Smith teaches to use a solder material coating over spherical cores (both solid and hollow). The AAPA merely notes that the plurality of microvoids present in prior art solder structures (shown in exaggerated detail in Fig. 2) have a cumulative gaseous volume of less than 0.1% of the total solder structure volume. In combining these two teachings, the most that one of skill in the art can obtain is limited to the teachings of Smith because the AAPA is simply a description of Smith's fusible conductive material, i.e., prior art solder material. No amount of extrapolation would lead one of skill in the art to replace the spherical cores of Smith with the microvoids of the AAPA while at the same trying to adapt the microvoids to have the same volume as the spherical cores of Smith -- something that Smith expressly discourages as unworkable. Moreover, it is hard to imagine how one of ordinary skill in the art would coat a void with fusible conductive material without using Smith's spherical

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core. The simple act of coating a void would eliminate the void as the fusible conductive material would simply coalesce (when in molten state) as expressly contemplated and warned against by Smith (col. 9, lines 12-18).

In view of the above remarks, Applicants respectfully submit that the rejection of independent claims 4, 7 and 12 under 35 U.S.C. § 103(a) is hereby traversed and that these claims are now in condition for allowance. Moreover, in regard to dependent claims 5, 6, 8-11, and 13-18, applicants respectfully submit that these claims are based on independent claims now deemed allowable, and on that basis, applicants respectfully submit that these dependent claims 5, 6, 8-11, and 13-18 are also in condition for allowance.

5. New claims 19-36.

New claims 19-36 are presented directed to alternate embodiments of the present invention. No new matter has been introduced by way of entry of new claims 19-36. Entry and examination on the merits thereof are respectfully requested.

**IV. Conclusion**

In view of the amendments and remarks made herein, applicants respectfully submit that claims 1-18 as well as new claims 19-36 of the present application are now in condition for allowance, and notification to that effect is respectfully requested.

Finally, while applicants believe that the instant response places the application in condition for allowance, if the Examiner believes that additional discussion or further information is necessary, it is requested that the Examiner contact the undersigned at the telephone number listed below to expedite resolution of any outstanding issues.




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In view of the foregoing amendments and remarks, favorable reconsideration is respectfully requested, and an early Notice of Allowance is earnestly solicited.

Respectfully submitted,

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PETITION and  
DEPOSIT ACCOUNT CHARGE AUTHORIZATION

This document and any concurrently filed papers are believed to be timely. Should any extension of the term be required, applicant hereby petitions the Director for such extension and requests that any applicable petition fee be charged to Deposit Account No. 50-1645.

If fee payment is enclosed, this amount is believed to be correct. However, the Director is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-1645.

Any additional fee(s) necessary to effect the proper and timely filing of the accompanying papers may also be charged to Deposit Account No. 50-1645.